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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

**IN RE APPLICATION OF:**

**KIM ET.AL.**

**SERIAL NO. : 10/624,254**

**Examiner: A. Austin**

**Group Art Unit: 1775**

**FILED: JULY 22, 2003**

**FOR: Functional Coatings for the  
Reduction of Oxygen  
Permeation and Stress and  
Method for Forming the Same**

**Statement of the Substance of the Interview by Applicants**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

An interview on Nov. 9, 2006 with the Examiner was directed to the following independent claims 1, 13, 25, 31, 37, and 43 as last amended in an Amendment After Final filed on Oct. 4, 2006.

The Applicants contended:

**1. Section 112 rejection of claim 1 can be removed by amending the claim to include the limitation that cryomilling occurs before thermally spraying.**

1. A method for improving a thermal barrier coating comprising:

providing a substrate;

cryomilling MCrAlY without the inclusion of other metallic alloys to provide

providing a bond coat composed substantially only of nanocrystalline MCrAlY, where M is comprised of at least one of the group of ~~stands for either Co, Ni and/or Fe;~~ ;

~~using a thermal spray process~~ thermally spraying the nanocrystalline MCrAlY  
onto a metallic substrate; and  
providing a ceramic top coat on the nanocrystalline bond coat.

The Applicants understood that Examiner would be amenable to withdrawing the sec. 112 rejection if such an amendment were made. No agreement was entered.

**2. Section 112 rejection of claims 37 and 43 can be removed by claiming a nanocrystalline MCrAlY bond coat on the substrate without inclusion of other metallic alloys instead of a “fully nanocrystalline MCrAlY” layer.**

This is an accurate restatement of the disclosure of the specification. The specification includes multiple references to the fact that the disposed layer is a nanocrystalline MCrAlY layer without any other metallic alloys in it, or that the metallic alloy system used in the layer is only composed of MCrAlY.

37. (currently amended) A MCrAlY thermal barrier coating made from MCrAlY powder, where M is a metal or metal alloy, comprising:

a substrate;  
a ~~fully-nanocrystalline~~ MCrAlY bond coat on the substrate without inclusion of other metallic alloys; and  
a ceramic top coat on the fully nanocrystalline bond coat.

43. (currently amended) A MCrAlY thermal barrier coating made from MCrAlY powder, where M is a metal or metal alloy, comprising:

a substrate;

a ~~fully~~-nanocrystalline MCrAlY bond coat without inclusion of other metallic alloys on the substrate;

a ceramic top coat on the ~~fully~~-nanocrystalline bond coat; and

an Al<sub>2</sub>O<sub>3</sub> nanoparticle additive disposed throughout the ~~fully~~-nanocrystalline MCrAlY bond coat which Al<sub>2</sub>O<sub>3</sub> nanoparticle additive was added during cryomilling of ~~the a~~ MCrAlY powder from which the nanocrystalline MCrAlY bond coat was formed.

The Applicants understood that Examiner would be amendable to withdrawing the sec. 112 rejection if such an amendment were made. No agreement was entered.

**3. Section 102 rejection of claims 1, 13, 25, 27, 31, 33 and 37 over Hebsur '725 can be removed by noting:**

- **That Hebsur '725 only discloses a NIAL and CoCrAlY system; and**
- **Each of the claims is limited to bond coat composed substantially of nanocrystalline MCrAlY without inclusion of other metallic alloys.**

1. A method for improving a thermal barrier coating comprising:  
providing a substrate;

cryomilling MCrAlY without the inclusion of other metallic alloys to provide  
~~providing a bond coat composed substantially only of nanocrystalline MCrAlY, where M~~  
is comprised of at least one of the group of ~~stands for either Co, Ni and/or Fe, ;~~  
using a thermal spray process thermally spraying the nanocrystalline MCrAlY  
onto a metallic substrate; and  
providing a ceramic top coat on the nanocrystalline bond coat.

13. (currently amended) A thermal barrier coating comprising:  
a substrate;  
a bond coat substantially ~~only composed of nanocrystalline MCrAlY~~ without  
inclusion of other metallic alloys, where M is comprised of at least one of the group of  
~~stands for either Co, Ni and/or Fe, using a high velocity oxy fuel (HVOF) thermal spray~~  
~~process or low pressure plasma (LPPS) spray process onto a metallic substrate on the~~  
substrate; and  
a ceramic top coat on the ~~nanostructured, nano-composite bond coat~~.

25. (currently amended) A method for improving a MCrAlY thermal barrier coating  
made from MCrAlY powder, where M is a metal or metal alloy, comprising:  
providing a MCrAlY bond coat on a substrate; and  
providing a nanocrystalline nano-composite coating on the MCrAlY bond coat  
without inclusion of other metallic alloys with a where the nanostructured nano-  
~~composite bond coating is prepared only by refining the microstructure of the a~~ MCrAlY

powder used to make the nanostructure nano-composite coating to nanocrystalline grain size.

31. (currently amended) A MCrAlY thermal barrier coating made from MCrAlY powder, where M is a metal or metal alloy, comprising:  
a MCrAlY bond coat on a substrate; and  
a nanostructured nano-composite bond coat with nanocrystalline size MCrAlY grains without inclusion of other metallic alloys on the MCrAlY bond coat on the a substrate.

37. (currently amended) A MCrAlY thermal barrier coating made from MCrAlY powder, where M is a metal or metal alloy, comprising:  
a substrate;  
a ~~fully~~-nanocrystalline MCrAlY bond coat on the substrate without inclusion of other metallic alloys; and  
a ceramic top coat on the fully nanocrystalline bond coat.

43. (currently amended) A MCrAlY thermal barrier coating made from MCrAlY powder, where M is a metal or metal alloy, comprising:  
a substrate;  
a ~~fully~~-nanocrystalline MCrAlY bond coat without inclusion of other metallic alloys on the substrate;  
a ceramic top coat on the ~~fully~~-nanocrystalline bond coat; and

an Al<sub>2</sub>O<sub>3</sub> nanoparticle additive disposed throughout the fully-nanocrystalline MCrAlY bond coat which Al<sub>2</sub>O<sub>3</sub> nanoparticle additive was added during cryomilling of ~~the a~~ MCrAlY powder from which the nanocrystalline MCrAlY bond coat was formed.

The Applicants understood that Examiner would be amendable to withdrawing the sec. 102 rejection if such an amendment were made. No agreement was entered.

**4. Section 103 rejection of claim 43 over Hebsur '725 and '654 can be removed by noting that Hebsur '725 and '654 only teach in situ formation of alumina in a NiAl system and that Hebsur '725 does not teach formation of alumina during cryomilling<sup>1</sup>.**

Claim 43 is directed to a step of providing an alumina coating by cryomilling an alumina powder to achieve nanocrystalline grain sizes and disposing the cryomilled nanostructured alumina composite coating on a bond coat on the substrate.

43. (currently amended) A MCrAlY thermal barrier coating made from MCrAlY powder, where M is a metal or metal alloy, comprising:

a substrate;

a ~~fully~~-nanocrystalline MCrAlY bond coat without inclusion of other metallic alloys on the substrate;

a ceramic top coat on the ~~fully~~-nanocrystalline bond coat; and

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<sup>1</sup> See page 9 of the Office Action in reference to claims 34, 35.

an  $\text{Al}_2\text{O}_3$  nanoparticle additive disposed throughout the fully-nanocrystalline MCrAlY bond coat which  $\text{Al}_2\text{O}_3$  nanoparticle additive was added during cryomilling of ~~the a~~ MCrAlY powder from which the nanocrystalline MCrAlY bond coat was formed.

The Applicants understood that Examiner did not contest the argument or offer a basis of refutation from any of the cited references. The teaching of Hebsur '725 relating to Fig. 5 was distinguished by Applicants. No agreement was entered.

**5. Section 103 rejection of claim 31 over Hebsur '725 in view of Cybulsky can be removed by noting:**

- **That Cybulsky discloses a MCrAlY protective coating 18 disposed between a substrate 12 and a bond coat 20 of Ir-Nb alloy; and**
- **That Hebsur teaches a NiAl-MCrAlY bond coat system,**
- **Therefore the combination of Cybulsky with Hebsur might suggest placing a second layer of MCrAlY between the NiAl- MCrAlY bond coat and the substrate, but there is no teaching, motivation or inference that the second layer of MCrAlY must be a nanostructured nano-composite layer.**

Cybulsky is totally silent with respect to the crystalline structure or sizing of the second layer of MCrAlY and never mentions cryomilling in any context. Cybulsky's second layer is for protection of the substrate against oxidation and hot corrosion and has no connection with bonding. There is no inference that this characteristic would be important for an intermediate bond coat or that the MCrAlY would need a


nanostructured nano-composite second bond coat underneath it. Nothing in Hebsur '725 is related to MCrAlY-nanocoating MCrAlY-bond coats.

31. (currently amended) A MCrAlY thermal barrier coating made from MCrAlY powder, where M is a metal or metal alloy, comprising:

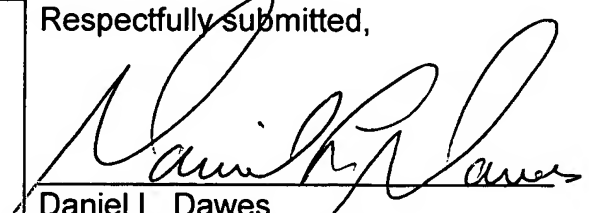
- a MCrAlY bond coat on a substrate; and
- a nanostructured nano-composite bond coat with nanocrystalline size MCrAlY grains without inclusion of other metallic alloys on the MCrAlY bond coat on the a substrate.

The Applicants understood that Examiner did not contest the argument or offer a basis of refutation in any of the cited references. Further search was cited as possibly needed. No agreement was entered.

Applicant respectfully requested advancement of the claims to allowance.

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on <u>November 27, 2006</u> by <u>To Ann Brewer</u> .	
 Signature	<u>11/27/06</u>
<u>November 27, 2006</u>	

Respectfully submitted,

  
Daniel L. Dawes  
Registration No. 27,123  
Myers Dawes Andras & Sherman LLP  
19900 MacArthur Blvd., 11<sup>th</sup> Floor  
Irvine, CA 92612  
(949) 223-9600

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